

## CODE

### 21.10 — Foundations

#### 21.10.1 — Scope

**21.10.1.1** — Foundations resisting earthquake-induced forces or transferring earthquake-induced forces between structure and ground shall comply with 21.10 and other applicable code provisions.

**21.10.1.2** — The provisions in this section for piles, drilled piers, caissons, and slabs on grade shall supplement other applicable code design and construction criteria. See 1.1.5 and 1.1.6.

#### 21.10.2 — Footings, foundation mats, and pile caps

**21.10.2.1** — Longitudinal reinforcement of columns and structural walls resisting forces induced by earthquake effects shall extend into the footing, mat, or pile cap, and shall be fully developed for tension at the interface.

**21.10.2.2** — Columns designed assuming fixed-end conditions at the foundation shall comply with 21.10.2.1 and, if hooks are required, longitudinal reinforcement resisting flexure shall have 90 degree hooks near the bottom of the foundation with the free end of the bars oriented towards the center of the column.

**21.10.2.3** — Columns or boundary elements of special reinforced concrete structural walls that have an edge within one-half the footing depth from an edge of the footing shall have transverse reinforcement in accordance with 21.4.4 provided below the top of the footing. This reinforcement shall extend into the footing a distance no less than the smaller of the depth of the footing, mat, or pile cap, or the development length in tension of the longitudinal reinforcement.

**21.10.2.4** — Where earthquake effects create uplift forces in boundary elements of special reinforced concrete structural walls or columns, flexural reinforcement shall be provided in the top of the footing, mat or pile cap to resist the design load combinations, and shall not be less than required by 10.5.

**21.10.2.5** — See 22.10 for use of plain concrete in footings and basement walls.

## COMMENTARY

### R21.10 — Foundations

#### R21.10.1 — Scope

Requirements for foundations supporting buildings assigned to high seismic performance or design categories were added to the 1999 code. They represent a consensus of a minimum level of good practice in designing and detailing concrete foundations including piles, drilled piers, and caissons. It is desirable that inelastic response in strong ground shaking occurs above the foundations, as repairs to foundations can be extremely difficult and expensive.

#### R21.10.2 — Footings, foundation mats, and pile caps

**R21.10.2.2** — Tests<sup>21.50</sup> have demonstrated that flexural members terminating in a footing, slab or beam (a T-joint) should have their hooks turned inwards toward the axis of the member for the joint to be able to resist the flexure in the member forming the stem of the T.

**R21.10.2.3** — Columns or boundary members supported close to the edge of the foundation, as often occurs near property lines, should be detailed to prevent an edge failure of the footing, pile cap, or mat.

**R21.10.2.4** — The purpose of 21.10.2.4 is to alert the designer to provide top reinforcement as well as other required reinforcement.

**R21.10.2.5** — In regions of high seismicity, it is desirable to reinforce foundations. Committee 318 recommends that foundation or basement walls be reinforced in regions of high seismicity.